

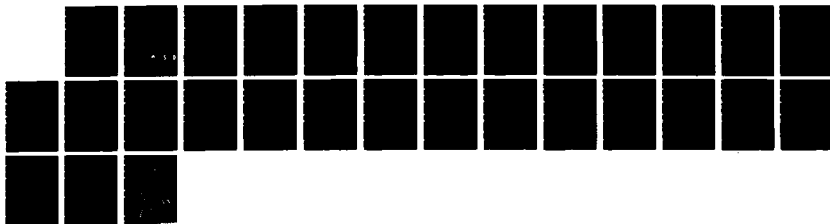
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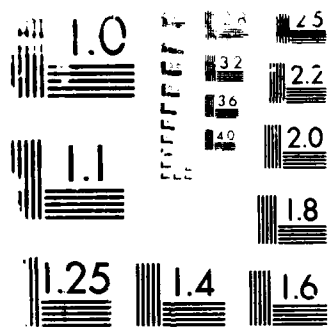
AN EVALUATION OF AFIT'S GRADUATE PROGRAMS IN OPERATIONS 1/1  
RESEARCH (GOR) AND STRATEGIC AND TACTICAL SCIENCES  
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AN EVALUATION OF  
AFIT'S GRADUATE PROGRAMS  
IN  
OPERATIONS RESEARCH (GOR)  
AND  
STRATEGIC AND TACTICAL SCIENCES (GST)

PERFORMED BY  
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DEAN OF THE FACULTY  
UNITED STATES AIR FORCE ACADEMY  
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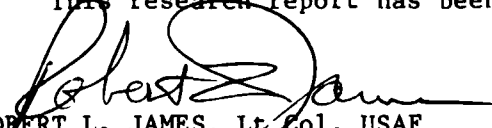
AUGUST 1987

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This research report is presented as a competent treatment of the subject, worthy of publication. The United States Air Force Academy vouches for quality of the research, without necessarily endorsing the opinions and conclusions of the authors.

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This research report has been reviewed and is approved for publication.



ROBERT L. JAMES, Lt Col, USAF  
Director of Research, Studies  
and Analysis

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AN EVALUATION OF  
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OPERATIONS RESEARCH (GOR)  
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STRATEGIC AND TACTICAL SCIENCES (GST)

Performed by

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August 1987

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AN EVALUATION OF AFIT'S GRADUATE PROGRAMS IN  
OPERATIONS RESEARCH (GOR) AND STRATEGIC AND TACTICAL SCIENCES (GST)

EXECUTIVE SUMMARY

At the request of the head of the Department of Operational Sciences, Air Force Institute of Technology (AFIT), a seven-member committee was formed to evaluate two graduate programs which they offer. These two programs, the Graduate Operations Research (GOR) and Strategic and Tactical Sciences (GST) Programs, result in a Master of Science Degree in Operations Research. After reviewing these programs and visiting the campus at Wright-Patterson AFB, near Dayton, Ohio, the committee has concluded that both programs are exceptionally effective in meeting the goal of preparing military officers for roles requiring scientific analysis and decision making skills. In general, the resident faculty is competent, the curricula are strong, and the student body is energetic, qualified and motivated. Moreover, most graduates of these programs are employed in positions that require the skills developed, and supervisors are pleased with their performance.

The predominantly military faculty provides some unique strengths to the program as well as a few drawbacks. The faculty does not have the teaching experience observed at civilian universities, but they make up for this with a strong dedication to teaching. Technical expertise, due in large part to recently completed doctoral studies, is exceptionally high. The students identify well with the Air Force and Army faculty and are highly motivated to study the subject material, especially when the faculty is able to demonstrate its relevance. The faculty is very responsive to student needs, a trait which is often not found at civilian institutions.



The required core curriculum is uncommonly strong compared to civilian programs. Students are provided "brush-up" review courses to give them prerequisite skills. Application of computers (of all sizes) is growing rapidly. Exceptional financial and facility support is evident in the rapid growth of available computer hardware and software.

Although the committee found both graduate programs strong and effective, we noted several areas of concern. The most notable problems involve faculty manning and institutional support from Air Force agencies. Specifically, the teaching experience of the military faculty is quite low, and many have not completed their doctoral dissertation requirements. The head of the Department of Operational Sciences will be leaving with no designated replacement; the Department of Mathematics and Computer Science had been without a department head for over two years. (A new head was hired on 6 July 1987.) In addition, both departments are undermanned. The support the faculty and students receive from Air Force personnel agencies is somewhat debilitating to the effectiveness of the programs. These problems are certainly not of crisis proportion and may be cyclical in nature due in large part to the predominantly military faculty. However, the Department Head spends considerable time procuring future faculty members and the students must invest significant time and effort to assure that their follow-on assignment is consistent with their skills and desires.

We have two recommendations to ameliorate these personnel problems: extended tours for military faculty and an AFIT Operational Sciences (AFIT/ENS) "advocate" at the Air Staff level. Tours could be extended by adding two years to initial assignments and by establishing bona fide tenured positions for military faculty. Creating a Senior 268X Advisory Board, consisting of

Commanders/Directors of major user agencies, would place more attention on careful matching of graduate qualifications and job requirements. (The Army has a comparable FA49 Advisory Board, which meets twice a year.) High-level support for AFIT/ENS and its programs will reap other benefits as well, including a significantly reduced administrative burden on the faculty and increased status of the programs in the eyes of prospective students.

Another area cited for potential improvement is faculty development, which would benefit from a comprehensive and ongoing faculty development plan. As part of this plan, all new instructors should receive instruction on techniques appropriate for graduate-level teaching before they begin their first quarter. An "instructional mentor" program might also be effective.

A few minor areas of criticism involve specific curriculum issues. Students would benefit from an introductory block of instruction about operations research as a profession, including its history and development. Several specific subjects are covered too lightly. The integration of economics in the programs is weak. Solutions to these problems would be fairly easy to implement.

We have discussed all items in detail in the body of this report. Again, the committee unanimously feels that, on the whole, the programs offered by the Department of Operational Sciences are viable, creditable, and very effective in meeting their stated goals.

## BACKGROUND

Col Michael O'Connell, the Head of the Department of Operational Sciences in the School of Engineering, Air Force Institute of Technology (AFIT) requested that a committee be formed to evaluate two programs offered by his department. The US Air Force Academy accepted the task and organized the following team:

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This evaluation is based on a review of the programs at the Department of Operational Sciences, School of Engineering, AFIT (AFIT/ENS), research on comparable programs, interviews with AFIT graduates and their supervisors, and campus visits by members of the committee. We researched procedures typically followed by accreditation boards and decided to follow the procedures and criteria established by the Accreditation Board for Engineering and Technology (ABET), as expressed in their 1985 Annual Report. This body has accredited operations research programs including the one offered by the Department of Mechanical Engineering at the University of Texas. Before visiting the AFIT campus at Wright-Patterson AFB, members of the committee reviewed materials provided by the Department of Operational Sciences and interviewed several graduates of their programs who are on the faculty at the Air Force Academy. On two separate visits we interviewed faculty and students, observed classes and thesis defenses, toured the facilities, and examined course materials in greater depth.

The body of this report follows the general criteria suggested by the ABET Report. Each area evaluated is discussed separately, including observations of members of the committee and their recommendations.

Beforehand, however, we must commend the spirit of cooperation we received from Col O'Connell, his faculty, and other members of the staff and faculty of the School of Engineering. We also want to thank Lt Col Joseph Faix for his superb job in coordinating our schedules and making our visits as productive as possible --this was a big task and it couldn't have been done better.

## CRITERIA

The criteria used are intended to provide a basis for a thorough evaluation of the program. It is difficult, indeed inappropriate, to establish firm guidelines on how to measure a program's effectiveness in satisfying a set of criteria. The ABET Report is quick to point out that the criteria should be applied with sufficient flexibility to allow for an institution's particular strengths, characteristics, and ideals. In fact, the report aptly states: "[The criteria] are intended to encourage and stimulate and not to restrain creative and imaginative programs." This is the spirit of our comments to follow.

### A. Faculty

1. Observations. The size and quality of the faculty is the heart and soul of any program. The Department of Operational Sciences has an energetic, vital faculty consisting of nine Air Force officers, one Army officer, and one civilian. The authorized strength is 13 instructors. This summer, two new civilian professors will be added, and the Department Head, Col O'Connell, will retire. Of the 11 assigned faculty members, 5 have not finished their doctoral dissertation requirements. Among the military faculty, the average graduate-level teaching experience is 1.9 years. The civilian instructor has 17 years of experience. Faculty members attended a wide range of respected graduate schools. This is also true of officers "in the pipeline" for PhDs and future assignment to AFIT. Typically, a new military member attends the Air Force's Academic Instructor School at Maxwell AFB during the first academic year. This three-week course is specifically developed for the AFIT faculty. Although the department intends to provide each faculty member a free quarter every year for professional development and research, low manning

interferes with this goal. The Department of Mathematics and Computer Science instructs four courses in the required core curriculum and offers several others supporting minor specialties, such as the reliability and maintainability sequence. The department has been directed by a succession of interim and acting heads over the past two years. A full-time civilian head was appointed in July 1987. Currently, the department has 17 instructors and the authorized strength is 21. Two of the assigned faculty have not completed their doctoral requirements. On the whole, the department plays a support role by offering and teaching courses in mathematics, probability, statistics, and computer science. Only one instructor is heavily involved with the students in the operations research programs and he is a thesis advisor for several students.

2. Strengths. The faculty are a dedicated and motivated group, committed to their students and AFIT's mission. They take a personal interest in their students and do everything possible to ensure successful completion of the program. The military members are usually fresh from graduate studies; thus, while their teaching experience is low compared to their civilian counterparts, their knowledge base is current and often relevant for military applications. The faculty's military experience in operations research lends important credibility to their teaching. The faculty is, and should remain, head and shoulders above their civilian counterparts in this area. Furthermore, the faculty research program seems excellent and relevant to current Air Force work in the field. An energetic faculty encourages students to research state-of-the-art developments, such as multiple criteria decision making and artificial intelligence. Through end-of-course critiques and interviews with

students, the committee has observed that the students are, with very few exceptions, very happy with their instructors, especially the military ones. Student-faculty interaction is exceptional. Students receive thorough and supportive counseling and advice. The faculty seems very willing to react to student criticisms and suggestions.

3. Weaknesses. The most obvious weakness observed is the large number of instructors who have not yet completed their doctoral dissertations, reducing the credibility of the institution, and thus its graduates, in the academic world. This problem is exacerbated by the heavy workloads imposed on the faculty, especially with respect to thesis advising. Most instructors have plans to complete their dissertations within a year or two, but this is a burden which distracts them from their primary teaching duties. In addition, the department head and one of his senior faculty spend an inordinate amount of time recruiting future faculty members. This process usually involves sponsorship for PhD studies enroute to a teaching assignment. AFIT must continually coordinate this recruiting with several Air Force agencies.

While the level of practical Air Force experience and involvement in military research is high, production of publishable research papers and involvement in professional societies is relatively low. Even though the low teaching experience of the faculty is mitigated by the strengths noted earlier, there are some distinct disadvantages. Academic rank is comparatively low and could detract from the program's prestige. We had some feedback that new instructors occasionally have trouble adapting to their new role; their lesson plans are weak and their lectures are ineffective in clarifying the material.

4. Recommendations. Several solutions are available to solve the problems with faculty experience and PhD completion. A tenure system could be established for military faculty with, perhaps, four year renewable options much like the system at the Air Force Academy. (AFR 36-20 and AUR 36-1 allow a similar kind of tenure.) This option is not without potential problems. Tenured instructors are removed from their military field of specialty, possibly leading to promotion pass-over. Conversely, officers could gain too much military rank for their position. Extending military assignments to six years should also be considered. Hiring more civilian faculty members could provide stability and expertise without some of the potential problems of military instructors; however, this could lead to a lack of flexibility and responsiveness in the department (one of the present strengths) and a consequent reduction of student/Air Force support and interest. The answer should be a judicious mix of civilian and military faculty, with a clear emphasis on the military. As a point of information, the Naval Postgraduate School has over a 90% civilian faculty, many with 20-25 years of tenured service. Defining the best military/civilian mix is a difficult problem, but one which can be addressed with pre-stated goals, e.g., three tenure military, plus three civilian and seven military faculty serving tours of four to six years. The committee feels that the military presence is paramount due to the nature of the programs, but it should be supplemented with a stable blend of compatible civilian experience. With the two civilian members that will be hired this summer, the department is definitely headed toward greater stability.

The relative weaknesses in faculty research and publishing should be addressed by encouraging more participation in professional meetings and joint student-faculty papers based on thesis work. However, top flight



researchers at civilian schools often cannot relate to students' problems and concerns; the AFIT faculty appears to be very good at the latter, which is far more important.

Concerning the teaching experience issue, we do not feel that attending the Academic Instructor School is sufficient for new graduate-level instructors. Graduate-level teaching at AFIT may require more detailed preparation in the AFIT environment. An internally managed faculty development program, aimed at improving teaching effectiveness, might be more productive. A short introductory course during the summer and a new instructor/mentor program involving practice lessons and tips on lesson planning and curriculum development could be the first phases of a comprehensive program. The Department Head should also ensure that new instructors are monitored and counseled early in their tours.

Because the faculty is very open to student criticism and comments, we caution against making changes based simply on student perceptions. Many times there are sound pedagogical reasons to make the students "suffer."

Recruiting new faculty members is also a major problem. The burden on the department would be greatly relieved if it could receive high-level support and assistance. We recommend a "force manager" for the 268X and related career fields be created at the Air Staff level to handle this and other issues. We've enumerated other benefits of having such an advocate later in this report. (See Page 21).

## B. Curricular Objective and Content

1. Observations. The curriculum is a strong, structured operations research program which leads to an excellent degree in this field. The core curriculum stresses courses in mathematical sciences (including probability and statistics), mathematical programming, stochastic processes, and applications. GOR students enter in the early summer and GSTs enter in September. The school takes advantage of this by offering a short term of review courses. The GOR and GST programs have different sets of courses in this short term. This was explained as necessary due to the difference in backgrounds and abilities of students, as well as differences in the curricula. Students in the GOR program are asked to select an emphasis area and those in the GST program must take a specialization sequence. Every student must write a thesis. The theses we observed or read covered a range of topics, but most were applications of simulation.

2. Strengths. The core program including the thesis requirement is the heart of the curriculum and its strongest feature. Clear structure provides focus and direction to the students. On the whole, the level and pace appear to be good. Starting the program with a short term of review courses is an outstanding idea. Students ultimately achieve a balance of theory, design and practice necessary for a good graduate-level program in a technical field. The thesis requirement is an excellent way to achieve several goals that ABET feels are important, including demonstration of competency in problem analysis and structure, research skills, and written communication. Students of the program are motivated by the applications orientation, and graduates feel confident that they have the ability to apply their skills. The application of computers, both micro- and mainframe,

in course work is growing rapidly. Individual members of the committee have singled out several courses and areas that appear particularly strong: probability, statistics, reliability, maintainability, linear programming, and artificial intelligence. Many of the courses make excellent use of relevant problems in military operations research. Maintaining course books in the departments is an effective way to insure continuity between course offerings.

While the pace could be criticized as being too intense, most of the students and faculty see it as a necessary evil given the need to cover so much material. Course content and sequencing has to be constantly reviewed to insure consistency and balance. We are reasonably convinced that this is being done. For example, a concern about the lack of time to cover stochastic processes seems already to be "on the mend"; the department is planning to increase this course from 3 to 4 credit hours, thus increasing classroom contact hours by 33%.

### 3. Weaknesses.

a. Introduction to Operations Research. Many of the students selected to these programs by the Air Force do not understand clearly what operations research is. Moreover, they have little appreciation for the history of operations research, its development, or its close association with planning, analysis, and evaluation of military operations. Thus, students do not gain an appreciation for operations research until they are well into their program. The solution recommended below should easily correct this deficiency.

b. Integration of Economics into the Program. To quote one member of the committee: "This is the one area that is weakest in the current program." The GOR students must take two courses in Economic Analysis (OPER 531 and 631); these are electives for the GST students. The students are dissatisfied with this part of their curriculum; they don't see the relevance and are not interested in the subject, largely because most of the problems and examples used are not related to military operations research. Some fundamental principles of economics (e.g., present/future value, costing, cost-benefit analysis, regression analysis, etc.) are scattered throughout the core. Unfortunately students do not see the subject for what it is: a field that spawned many operations research techniques and one which provided a foundation for much of operations research.

c. GOR versus GST Programs. The objectives of the GOR and GST programs are different, so their curricula vary somewhat. Despite these differences, however, both groups receive a Master of Science Degree in Operations Research. It appears that the GST program, is a "watered down" version of the GOR Program, especially in the mathematics area. This may give GST students the feeling that they are "second-class" citizens. The GST program includes much nuclear weapons physics (e.g. theory of how energy is released) that appears excessive and might be traded for more rigorous mathematics. Regardless of whether the problems incurred by two different programs are real or perceived, they need to be addressed.

d. Probability and Statistics. GST students must take only two quarters of probability and statistics. GORs take two quarters of probability and statistics and then an applied statistics elective. These difficult concepts are fundamental to the OR profession and yet are often misapplied by practitioners. It takes most students three passes through the concepts for them to take hold.

e. Interdisciplinary Team Management. Operations research as an interdisciplinary activity is beginning to make a comeback. No current university program addresses the skills necessary to organize and manage such an interdisciplinary team.

f. Thesis Research. While the committee feels that the thesis is an indispensable and pedagogically important requirement, several negative observations are worth mentioning. One committee member felt that the theses were closer to "Master's Projects." It appears that nearly all students select their thesis topics from a provided list, and most of these are applications of simulation. The result is less effort in, and hence less benefit from, the problem identification and definition phases of the thesis research. We recognize that there is a tradeoff between the benefits gained through student definition of thesis topics and those gained through doing research directly applicable for a DOD organization. Despite our observations or impressions, we are convinced that the thesis program is very effective in accomplishing its goals, as evidenced by comments from graduates (see paragraphs 2 and 3, page 20).

g. Miscellaneous Concerns. The rapid increase in microcomputer availability may hurt some students who are not as "computer literate" as others. Concerning other specific courses, one member of the committee feels that the linear programming course should include a discussion of Karmarkar's algorithm and application of standard software packages. Another member would like to see a course or set of courses in production/project management -- a sequence that would be applicable to military maintenance and overhaul facilities.

Game theory, data analysis, negotiations analysis, and physics also appear to be lightly treated or not covered. Several courses were relatively weak in problems and examples from military operations research. Concern was expressed regarding the significant number of "remedial" and/or "survey" courses compared to other quality graduate schools, which assume prerequisites are satisfied before entering the program or through no-credit courses.

#### 4. Recommendations

a. Introduction to Operations Research. The committee feels very strongly that students in the two programs should be provided with an appreciation for operations research as a subject and career field early in their program. Under present structure, students get a brief introduction in the second quarter with the Deterministic Methods course (OPER 663) and a final treatment in Analysis for Defense Systems (OPER 742) or Systems Analysis and Defense Planning (TACT 670), which occur late in the course of study. We recommend that the students receive a "warm-up" familiarization block of instruction either in the short summer term or in the first full quarter. This block of instruction should include the history of military operations research, introduction to the scientific method and the systems approach, and a discussion and illustration of some of the techniques that are now covered in OPER 663. Some discussion of the interdisciplinary and team nature of early operations research should also prove beneficial. This would have the advantage of motivating students for the subject and course of study to follow. As a side benefit, the OPER 663 course could then drop some material and cover the remaining subjects in greater depth.

b. Integration of Economics into the Programs. The students should discover the worth of economic theory and its relationship to widely used operations research techniques. Several texts are available for this type of integration, the most notable being Economic Theory and Operations Analysis, by William J. Baumol, and the classic Hitch and McKean book on defense decision making. The text could easily form the basis for a two-quarter, graduate-level course sequence that would be extremely helpful to an operations researcher who wanted to learn economics. In addition, many of the topics covered in the Baumol text are complementary to those covered in other courses in the curriculum (e.g., game theory, duality in linear programming, marginal analysis, etc.). Thus, the faculty could remove certain topics from other courses, leaving them for the economics sequence. Further, problems and examples with military relevance should replace the almost purely non-military ones. A review of courses taught by the Engineering-Economic Systems Department at Stanford might prove beneficial. Several members feel very strongly that econometrics be a required third course in this sequence. Other committee members feel, however, that time pressures dictate that it should be an elective. These recommendations would serve the dual purposes of showing the students the complementary nature of the two disciplines, while elucidating the economic aspects of operations research problems. Finally, the GST students should be encouraged or required to take a minimum of one course in economic analysis.

c. GOR versus GST Programs. While the need for two separate programs was justified to us very well by the faculty, the students rarely get to choose their program. From the beginning, they pursue separate tracks toward the same degree. This is especially true in the first required mathematics course--

MATH 503 (GST) versus MATH 509 (GOR). This early tracking leads to some undesirable perceptions. We recommend the department consider having both programs start with a common core in the short review term and first quarter.

d. Three quarters of probability and statistics, or deliberate reinforcement of key concepts in other courses, is strongly recommended.

e. Operations research as an interdisciplinary activity is worthy of research and coverage in the curriculum. One way to begin consideration of this topic might be through guest lectures on subjects relevant to military operations research by historians, physical scientists, psychologists, sociologists, project managers, and others. The faculty might also research and teach techniques for integrating team efforts and the concepts of project management.

f. Miscellaneous. Under the present system, students do not often transfer credits or validate courses from other programs or schools. In addition, they typically must take all review courses offered during the short review terms. We recommend some validation/transfer credit to allow brighter students more flexibility with their programs. Current courses could also include materials on game theory, data analysis, negotiations analysis, and goal programming. Some of the linear programming topical coverage might be reduced to compensate for this. A course on "modern physics" should be included, because an OR practitioner needs to understand modern technology. And, as for the economics courses, we recommend continued efforts to find and include problems and examples from military operations research. In a different area, we recommend that the school look at the "computer literacy" issue. The Department may want to provide a short course on microcomputers for the entering students to familiarize them with the operating systems, word-processing, spread sheets, graphics, etc., that will be available. AFIT/ENS needs to develop a comprehensive plan for the thoughtful and purposeful integration of microcomputing across the entire curriculum.



### C. Student Body

In general, the committee found this area to be outstanding. We have only a few recommendations to make after the discussing our observations.

1. Admissions Policy and Student Performance. Students apply for the program by submitting an application for AFIT selection. Marginal applications are reviewed by the School of Engineering and Department of Operational Sciences. The GOR program has the only published minimum undergraduate GPA, which is 3.00. While the School of Engineering would prefer a 3.00 or better GPA, the department may waive this preference after reviewing other factors, including GRE scores. The AFIT Central Selection Board and the Army's equivalent then approve 18-24 students for entry into each program. They typically identify the officers with weapon system experience for the GST program. The resulting student body consists of a heterogeneous mix of Air Force, Army, and foreign service officers. The committee feels that this diversity is good for the programs. Data for the current class and the three previous classes are in Table 1.

	CLASS	NR	Undergraduate GPA		GRE Average		AFIT GPA	
			Aver	Low/High	Verb	Quant	Aver	Low/High
GOR	87D	24	3.20	2.20/3.83	515	682	--	--/--
	86D	20	3.27	2.74/3.93	526	696	3.62	3.02/4.00
	85D	22	3.19	2.61/3.81	532	686	3.49	2.90/3.94
	84D	18	3.01	2.11/3.67	503	700	3.56	3.20/4.00
GST	87M	19	3.12	2.28/3.87	536	684	--	--/--
	86M	23	3.04	2.50/3.63	557	714	3.54	3.16/3.99
	85M	22	3.12	2.23/3.89	605	673	3.55	3.27/4.00
	84M	22	3.05	2.44/3.80	555	694	3.68	3.23/3.99

TABLE 1. REGISTRAR DATA ON GOR AND GST CLASSES

A quick review of student performance for the past three graduating classes shows that the success rate is extremely high. Only 8 of 127 students failed to complete the program within 24 months of entry. Two of the eight who did not finish were transferred to the School of Systems and Logistics where they completed a different Master's degree. Those students who entered with less than 3.00 undergraduate GPAs performed almost as well as those who met the desired standard. These data are in Table 2.

	Undergrad GPA less than 3.00		Undergrad GPA greater than 3.00	
	Nr	AFIT GPA	Nr	AFIT GPA
GOR	20	3.50	40	3.58
GST	28	3.52	39	3.63

TABLE 2. COMPARISON OF GPAs (Classes of 1984-1986)

2. Student Attitude. Clearly, the GOR and GST students are committed to their studies, professional in their approach, and extremely hard working. Their competitiveness and camaraderie undoubtedly enhance the learning environment. In fact, students commented that they learn as much from their classmates as they do in class. They are supportive and display class unity. Their morale is high, although they have typical student gripes. Individuals complained about courses with too much theory, others with too much application, instructors who teach "cook book" style, and instructors who do not have enough structure in their classes--evidence of differences in learning styles among students. As a group, however, they had little tolerance for and were very critical of a few poor instructors, criticizing organization, communications, pacing, and appearance. The committee generally views these as typical student grips, which are normal and reflective of a healthy, challenging program. The students displayed a healthy thirst for knowledge, but some stated that they would rather take more courses

than research and write a thesis. Graduates, on the other hand, unanimously indicated that their thesis work did more than anything else to tie the entire program together and to prepare them for the complex problems they would encounter in their subsequent duty tours. They wanted to specialize in particular subjects, including network theory, stochastic processes, artificial intelligence, and response surface methodology--clear evidence of the subject stimulation they received in just one year of studies. To a person, they are proud of their program.

3. Success of Graduates. The committee interviewed graduates who were stationed at the Air Force Academy and Wright-Patterson AFB. We also talked with their supervisors. All graduates are succeeding, although not all are employing the skills they developed in the GOR or GST programs. For example, some are in units that contract out studies and analysis problems the graduates are eager to do themselves. All graduates said they are very confident of their skills, and this was especially fostered by the thesis requirement. Their employers "could not be more pleased" with their performance. They found GOR/GST graduates to be technically sound, adaptive and insightful. Furthermore, they display an ability to synthesize and extend their knowledge to new areas of application. Some commented on AFIT graduate strengths in computer skills, synthesis, and design. Many mentioned a healthy competitive spirit that carried over from their AFIT studies and many stated they preferred to employ AFIT graduates over graduates of civilian programs!

4. Recommendations. The students are often burdened with finding good assignments for themselves before graduation. This seems paradoxical, because these students should be heavily recruited by agencies needing officers with a state-of-the-art education in operations research. We recommend that graduates of these programs receive special attention when it comes to assignments. Hiring agencies should be competing for them much like the situation in the civilian community. This could be done via a "job fair" or a "career day" held prior to assignment selection. As mentioned earlier, the installation of a "force manager" for the 268X and related career fields at the Air Staff level could insure that more attention is placed on the proper use of officers. Creating a Senior 268X Advisory Board consisting of the Commanders/Directors of the major using agencies would be comparable to the FA49 Advisory Board in the Army. This board should meet twice a year and have strong control over the use of 268X officers, and hopefully influence the personnel system in a very positive way, especially through the Scientific Analyst Career Monitor Office already established at USAFMPC. This board would also relieve some of the recruiting burden experienced by the department head in hiring new instructors.

#### D. Administration and Institutional Commitment

Cooperation and good communications abound among the administration elements and the faculty at the School of Engineering. Unfortunately, this is threatened by the lack of continuity brought about by the rotating vacancies in military faculty and department head positions. Furthermore, external pressure brought about by the personnel system, especially as mentioned in the faculty and student body sections earlier, is causing problems. The financial support provided to the school seems adequate. TDY budgets appear sufficient for professional development efforts. The library appears well stocked. The rapid growth in computer and software availability over the past few years is probably the most visible sign of institutional support. The only recommendation we have is the call again for high-level institutional support with the installation of an "advocate" or "force manager" who could assist in recruiting top notch faculty and overseeing assignments for the graduates.

## SUMMARY

The committee is pleased to give the impressive GOR and GST programs an excellent rating. The Department of Operational Sciences has a competent faculty and an energetic student body. The core program, along with the elective sequences and the thesis requirement, provides the graduates an exceptional background compared to their civilian counterparts. The Department of Operational Sciences and its programs can be made even stronger by addressing the weaknesses and considering the recommendations contained in this report. But these weaknesses and recommendations do not change the fact that the Department of Operational Sciences is meeting its mission exceptionally well. This committee can think of no higher endorsement than the one given by the supervisors of GOR/GST graduates: they would be happy to have as many GOR/GST graduates as they can get.

END

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